SOCRATES Liquid Precipitation Properties Retrieval Product, Version 1.0

Authors

Litai Kang
Affiliation: University of Washington, Department of Atmospheric Sciences, Seattle, WA, USA
Email: kanglt@uw.edu
ORCID: 0000-0001-6121-860X

Roger Marchand
Affiliation: University of Washington, Department of Atmospheric Sciences, Seattle, WA, USA
Email: rojmarch@uw.edu
ORCID: 0000-0002-5218-6762

Robert Wood
Affiliation: University of Washington, Department of Atmospheric Sciences, Seattle, WA, USA
Email: robwood2@uw.edu
ORCID: 0000-0002-1401-3828

1.0 Oveview

This dataset contains retrievals of liquid precipitation properties for the Southern Ocean Cloud Radiation and Aerosol Transport Experimental Study (SOCRATES) during January and February 2018. Liquid-phase precipitation properties are retrieved where radar and lidar are zenith-pointing using radar reflectivity-velocity retrieval and radar-lidar retrievals. For more information on SOCRATES, see McFarquhar et al.(2021) and SOCRATES field catalog https://catalog.eol.ucar.edu/socrates. The liquid precipitation properties were derived using observations from the W-band HIAPER Cloud Radar (HCR) and High Spectral Resolution Lidar (HSRL) on board the Gulfstream-V High-performance Instrumented Airborne Platform for Environmental Research (GV-HIAPER) aircraft. The retrieval process are briefly described in Section 3.0. For detailed information on the retrieval process and validation results, please refer to Kang et al. (2024).

2.0 Instrument Description

The dataset is derived based on data from remote sensors include a 94-GHz W-band HIAPER Cloud Radar(HCR) (Vivekanandan et al., 2015) and a 532-nm High Spectral Resolution Lidar (HSRL) (Eloranta, 2005). The radar and lidar moments data version 3.1 were used as inputs for the retrieval algorithm and were processed by NCAR/EOL at 2 Hz (0.5 seconds) temporal resolution and 19 meters range vertical resolution. A detailed description of the HCR and HSRL Specifications, NCAR/EOL data processing and corrections are given in data readme file at https://data.eol.ucar.edu/file/download/53A7DB6F02CE2/readme_HCR_HSRL_SOCRATES_v3.2.pdf.

3.0 Data Collection and Processing

In brief, this dataset focuses on periods when the radar and lidar are zenith-pointing and when the precipitation falling from the clouds is in the liquid phase, as determined by the lidar particle linear depolarization ratio (PLDR). Once the precipitation phase is determined, two different retrieval techniques are used to derive the liquid precipitation properties: (1) a radar reflectivity-velocity retrieval (ZV retrieval) following Mace et al. (2002) and Marchand et al. (2007); (2) a radar-lidar retrieval following O'Connor et al. (2005). The detailed information of the retrieval process can be found in Kang et al. (2024).

4.0 Data file structure and content

The dataset is produced in the Network Common Data Format (NetCDF). Each file is one zenith-pointing segment. Two classes of files represent the data from two different retrievals:

zv.RF##.B.YYYYMMDD_hhmmss_to_ YYYYMMDD_hhmmss_v1.0.nc
rl.RF##.B.YYYYMMDD_hhmmss_to_ YYYYMMDD_hhmmss _v1.0.nc

where *zv* and *rl* represent radar reflectivity-velocity retrieval and radar-lidar retrieval, respectively; *RF##* represent the flight number, and *YYYYMMDD_hhmmss_to_ YYYYMMDD_hhmmss* represent the start and end UTC time of this segment.

The Tables below gives the information on variables in the files:

Table.1 Variables in the radar-lidar retrieval files

Variable	Dimensions	Unit	Description
time	dim_time	s	time in seconds since the segment starts
height	dim_time, dim_height	m	height relative to the ground
latitude	dim_time	degree	latitude of the aircraft
longitude	dim_time	degree	longitude of the aircraft
altitude	dim_time	m	altitude of radar
cloud_base	dim_time	m	cloud base height estimates
HCR_DBZ	dim_time, dim_height	dBZ	reflectivity factor
HCR_WIDTH	dim_time, dim_height	$m\ s^{-1}$	doppler spectral width corrected for turbulence and aircraft motion
HSRL_Beta	dim_time, dim_height	$m^{-1}\ sr^{-1}$	lidar backscatter coefficient
HSRL_PLDR	dim_time, dim_height	unitless	HSRL Particle Linear Depolarization Ratio
PLDR_bc_med_ts	dim_time	unitless	median HSRL Particle Linear Depolarization Ratio below cloud-base
D0	dim_time, dim_height	µm	median equivolumetric diameter
mu	dim_time, dim_height	unitless	median equivolumetric diameter
rain_rate	dim_time, dim_height	$mm\ hr^{-1}$	rain rate
N_precip	dim_time, dim_height	$\#\ m^{-3}$	precipitation number concentration
LWC_precip	dim_time, dim_height	$g\ m^{-3}$	precipitation liquid water content
D_precip	dim_time, dim_height	µm	Precipitation LWC-weighted mean diameter

sigma_precip	dim_time, dim_height	µm	Precipitation liquid water content weighted width

Table. 2 Variables in the ZV retrieval files

Variable	Dimensions	Unit	Description
time	dim_time	s	time in seconds since the segment starts
height	dim_time, dim_height	m	height relative to the ground
latitude	dim_time	degree	latitude of the aircraft
longitude	dim_time	degree	longitude of the aircraft
altitude	dim_time	m	altitude of radar
cloud_base	dim_time	m	cloud base height estimates
HCR_DBZ	dim_time, dim_height	dBZ	reflectivity factor
HCR_VEL_c	dim_time, dim_height	$m\ s^{-1}$	corrected doppler velocity
HSRL_PLDR	dim_time, dim_height	unitless	HSRL Particle Linear Depolarization Ratio
PLDR_bc_med_ts	dim_time	unitless	median HSRL Particle Linear Depolarization Ratio below cloud-base
D0	dim_time, dim_height	µm	median equivolumetric diameter
vt	dim_time, dim_height	$m\ s^{-1}$	reflectivity-weighted the terminal fall velocity
rain_rate	dim_time, dim_height	$mm\ hr^{-1}$	rain rate
N_precip	dim_time, dim_height	$\#\ m^{-3}$	precipitation number concentration
LWC_precip	dim_time, dim_height	$g\ m^{-3}$	precipitation liquid water content
D_precip	dim_time, dim_height	µm	Precipitation LWC-weighted mean diameter
sigma_precip	dim_time, dim_height	µm	Precipitation liquid water content weighted width

5.0 References

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